Investigating the Potential Health and Economic Benefits of Taxing Processed Meats

An Honors Thesis (HONR 499)

by

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Abstract

Processed meats are a part of many cultures' diets around the world. Despite research that outlines a strong correlation between processed meat consumption and chronic disease incidence, their consumption is nearly one fifth of all meat in the United States. With healthcare costs skyrocketing and Indiana's population health degenerating, it is important to better understand the possible impact of decreased consumption of processed meats on health in the Hoosier state. Drawing on the primary research of others, this paper investigates the potential health and economic benefits of a tax on processed meats.

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Process Analysis Statement

I conducted a meta-analysis literature review of published works pertaining to food price elasticities, health consequences of consuming processed meats, nutrition, health economics, public health, and public finance with the goal of better understanding the impact of and issues associated with a tax on processed meats.

I first sought out background information for my paper; this included a basic definition of processed meats, and the various procedures applied to raw meats that result in the final product. Next, I organized scientific-based research on disease incidence correlated to processed meats and gathered Indiana's disease reports for health data; this established a need for reduced consumption of processed meats in Indiana.

Second, I investigated food choices, tastes, and preferences which have starkly changed over the past few centuries. The last background-related aspect of my argument came next, which was building information on income's relation to food consumption patterns and finding relational data of processed meat consumption in the United States.

Third, I explored the price elasticity of processed meats in the analysis section of my paper. This was challenging because there is no definitive data on processed meat elasticity, but I extrapolated price elasticities for high value food items such as unprocessed meat or dairy to estimate the price sensitivities of individuals purchasing processed meats. Because income levels are highly correlated with the degree of individual price sensitivity, I emphasized that relationship to tie together my argument that a sales tax on processed meats would chiefly affect low income consumers.

Lastly, I studied the effectiveness of a sales tax on processed meats, and what factors might inhibit its effectiveness. This portion involved literature on cross price

elasticity, attitudes about diet, food and skill accessibility, sociocultural influences, and comparable studies on similar taxes. Additionally, I proposed applications of tax revenue that could contribute to improving population health.

The largest obstacle I encountered was seeking out research on how populations react to health economics-related policy change. Primarily, this was difficult because consumption behaviors are difficult to change because of the many independent variables that factor into lifestyle habits, culture, socioeconomic standing, and personal consumption practices.

Throughout this process, I learned to improve my research habits to become more efficient in the literature review process. I assessed sixty-seven published journal articles and numerous other resources, and learned that I work best with at least three hours of uninterrupted time to devote to research projects. My thesis is in an area of underdeveloped, emerging research that I predict will become an important piece of health economics in the future. I am proud of the work I have done.

Introduction

The prevalence of chronic disease in the United States has multiplied over the past century to nearly half of all adults living with one or more chronic health conditions (Centers for Disease Control and Prevention, 2017). In general, the consumption of energy-dense, processed foods is a strong contributor to the increase in chronic disease and obesity. It is thought that reducing caloric intake by "1 to 2% per year would have a marked impact on health in all age groups" in addition to considering the macronutrient consumption profile of diets (Brownell et al., 2009). Over the last few centuries, the United States has experienced an economic and demographic transformation, which has substantially changed food consumption patterns.

The United States allocates the highest proportion of its budget to healthcare. The U.S.'s healthcare spending as a percentage of gross domestic product has increased from 5.2% in 1960 to 17.9% in 2010 and continues to rise (Indiana State Department of Health, 2012). Diet is a significant contributor to chronic disease. Specifically, consumption of processed meats is positively associated with cancer and obesity because of the chemicals used to transform raw meat inputs into its final forms and high caloric contents, respectively. Since processed meats can harm human health, there is a need to construct policies like a tax on processed meats which may discourage consumption of processed meats and subsequently improve public health.

In this paper, I aim to understand the effects of a sales tax on processed meats. I intend to investigate the spending habits and the effects of price elasticity on consumption of processed meats across several income variables by examining the work of others. The goal of taxation is to reduce the incidence of chronic disease and decrease

healthcare costs in Indiana by decreasing consumption of processed meats. After the effectiveness of this tax on decreasing processed meat consumption is judged, such information could be used as an example for states nationwide to produce a healthier population.

Background

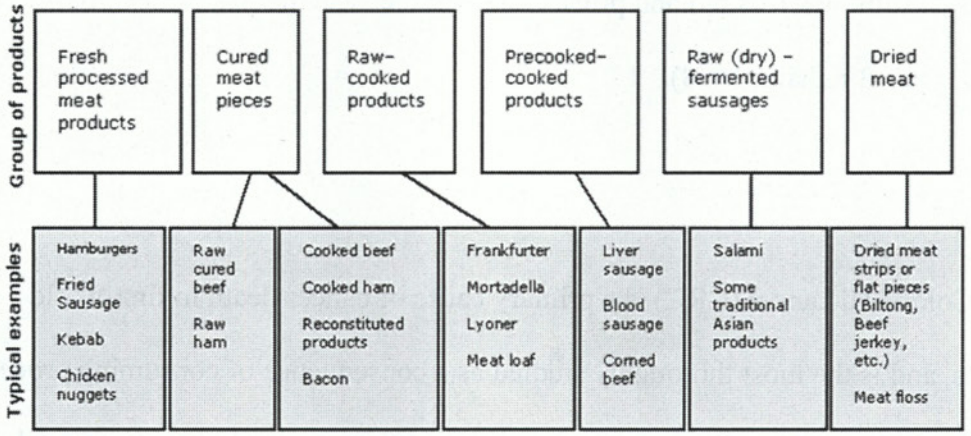
What is a processed meat?

The World Health Organization (WHO) defines processed meat as "meat that has been transformed through salting, curing, fermentation, smoking, or other processes to enhance flavour or improve preservation" (World Health Organization, 2015). The WHO classified processed meats as a Group 1 carcinogen, with substantial evidence backing the claim that they are carcinogenic to humans in 2015. Curing uses nitrates, nitrites, salts, and/or sugars to modify flavor and prevent bacterial growth; smoking exposes meat to phenols, aldehydes, acetic acid, and various carboxylic acids to change the flavor, color, and perishability of fresh meat (Santarelli, Pierre, & Corpet, 2008). Processed meats are found in a myriad of quick-cook, freezer, and packaged non-perishable foods such as sauces, microwavable dinners, and snack items.

The Food and Agriculture Organization of the United Nations categorizes processed meats into six broad categories based on the processing technologies used and materials used to transform raw materials into the finished product; the groups are called fresh processed meat products, cured meat pieces, raw-cooked products, precooked-cooked products, raw (dry)-fermented sausages, and dried meat (Heinz & Hautzinger, 2007). Specific food examples of these categories are identified in Figure 1, which was

originally published by the Food and Agriculture Organization of the United Nations in 2007.

Figure 1: Reprinted from Heinz & Hautzinger (2007).



According to Indiana's nutrition guidelines, examples of processed meats include assorted types of sausages, chicken patties, hot dogs, luncheon loafs, pork patties, bacon, and many more (Indiana Department of Education, 2011). These are widely used foods in a multitude of traditional American dishes and are increasingly becoming more popular as consumer tastes transition into grab-and-go convenience meals with little to no preparation. Highly refined food products consumed in moderate to large quantities accompanied with inadequate nutrition and a sedentary lifestyle may be attributed to epidemiologic issues including obesity, population aging, fertility reduction, blood diseases, and cancer.

Diet and Disease Incidence

Diet is one of the most important lifestyle factors that is approximated to contribute to 80% of incidences of cancer in the colon, prostate, and breast, in addition to

other immunologic and cardiovascular-related diseases (Cummings & Bingham, 1998). As a result, this proportion of disease occurrences may be preventable by dietary modifications, particularly regimens that limit or eliminate processed meats. Nutrition research has generally identified that "fruit, vegetables, and fiber have a protective effect on human health, whereas red and processed meat increase the risk of developing cancer" (Cummings & Bingham, 1998).

Cancer

Colorectal cancer (CRC) is a primary cause of cancer death in first-world countries, and is the most thoroughly studied as a consequence of consuming processed meats. The Indiana State Department of Health reports colorectal cancer as the "third most commonly diagnosed cancer and cause of cancer-related death among both males and females in the U.S. and Indiana" (2015). Because this variety of cancer is strongly affected by diet, food habits may reduce its onset by 70% (Santarelli, Pierre, & Corpet, 2008). In a complete global review of nutrition and cancer, the evidence that processed meat is a cause of cancer is convincing (World Cancer Research Fund/American Institute for Cancer Research, 2007). The epidemiologic studies published to date conclude that the excess risk for other types of cancer increase between 20% to 50% with routine consumption of processed meats.

Processed meats increase cancer risk due to a number of chemicals bound to its raw forms. One of the main transformational ingredients added to processed meats are nitrates (Santarelli, Pierre, & Corpet, 2008). Nitrates naturally occur in plant materials, but are chemically adapted into derivative compounds such as nitrites or nitric oxide to

preserve processed meats and provide flavor and color. Popular uses of these compounds outside of processing meats are in agricultural fertilizers, explosives, and pharmaceuticals.

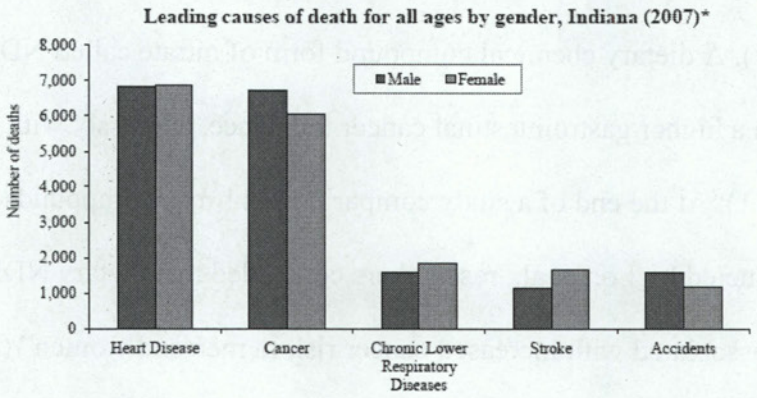
This is a concern because dietary nitrates and nitrites are converted in the body to N-nitroso compounds, which are probable human carcinogens that convert into toxins when processed in the body (World Cancer Research Fund/American Institute for Cancer Research, 2007). A dietary chemical compound form of nitrate called NDMA was associated with a higher gastrointestinal cancer incidence, expressly with rectal cancer (Loh et al., 2011). At the end of a study comparing N-nitroso compounds against cancer incidence conducted by Loh et al., researchers concluded that dietary NDMA intake was "significantly associated with increased cancer risk in men and women" (2011). Because processed meats have a high concentration of these by-products, they increase the probability of disease.

Obesity

Other lifestyle factors that increase risk for cancer and chronic disease is alcohol, increased body weight, smoking, and a sedentary lifestyle. Many types of processed meats have high caloric values or are typically paired with high calorie foods to complete a meal, which may contribute to the obesity epidemic in the United States. In Indiana, 65% of adults, 30% of children aged 10-17, and 29% of high school students are overweight or obese (Dwivedi & Raftery, 2011). In the same comprehensive report, Dwivedi & Raftery. recounted obese and overweight individuals have a higher incidence of high blood pressure (78%) and high cholesterol (78%), which contribute to a three

times higher diagnosis of chronic heart diseases within this sample (2011). By a large margin, heart disease and cancer are the leading causes of death for all ages of males and females in Indiana (Dwivedi & Raftery, 2011).

Figure 2: Reprinted from Dwivedi and Raftery (2011).



*Indiana State Department of Health, Indiana Mortality Report, 2007.

A Transition in Food Tastes

Global economies have grown and developed substantially over the past several hundred years, namely in the last 50 years; accompanying this, worldwide nutritional habits and tastes have changed as well towards affluent food choices and consumption behaviors. In part due to globalization, industrialization, and urbanization, food has shifted from participating as a strictly local market commodity to being involved in an international exchange alongside ideas, culture, and social norms, and the quantity produced means more food is available for consumption. These types of changes have led to "a marked shift in the structure of diet and the distribution of body composition in many regions of the world" and higher disease rates (Popkin, 1994).

According to Gerbens-Leenes, Nonhebel, & Krol (2010) food consumption patterns are defined as the "repeated arrangements of consumption, characterized by types and quantities of food items and their combination in dishes and meals"; additionally, income plus preferences, culture, and availability affect these patterns. Prosperous countries tend to consume more food items sourced from animals such as milk, cheese, and meat (Gerbens-Leenes, Nonhebel, & Krol, 2010). As growing countries increase per capital income and gross domestic product output, there is a clear shift towards a "Western" diet of highly refined, sugary, and fatty foods.

What impacts food choices?

How are food choices related to consumption? Gerbens-Leenes, Nonhebel, & Krol state that "consumption changes can cause shifts in the macronutrient composition of food consumption patterns" that can ultimately affect demand for entire food groups such as starchy crops, animal commodities, or oil crops (2010). Food production is driven by supply and demand in the market for certain groups of foods, and firms will cultivate products according to consumer wants and needs.

Sociocultural and workforce changes oriented towards instant gratification and busy lifestyles contribute to consumer choices of convenience, pre-prepared, and restaurant foods. Data collected by NHANES (National Center for Health Statistics for the Center for Disease Control and Prevention) proposes that various demographic factors have "cultural, social, regional, and financial influences on diet" and affect meat intake patterns (Daniel, Cross, Koebnick, & Sinha, 2011). Additionally, price and taste are a large determinant of food choices.

Income and Nutrition

A critical correlation has been verified by numerous studies between food consumption patterns and income. Income is dependent on economic conditions, national development, and income distribution within a population, and socioeconomic status certainly affects food consumption behaviors. The overarching trend of food consumption patterns among Americans is toward lower cost diets (Drewnowski & Darmon, 2005).

As household income rises, there tends to be an information shift from a nutritional perspective towards actively making healthy dietary choices and changes. Higher income groups tend to hold degrees from college and thereon, which corresponds to a greater proportion of income able to be allocated towards the purchase of healthier items that are often much more expensive. More educated groups of people make behavioral changes to adapt to a positive diet of high-fiber, low-fat foods and avoid processed items and red meat. Backing this, Daniel, Cross, Koebnick, & Sinha concluded that "poultry and fish consumption appear to increase with education level" (2011). This may be a result of higher income individuals' reception of government health campaigns advocating lower red meat intake in favor of fish or poultry. Additionally, higher income groups are not limited to inexpensive foods that hold low nutritional value and can more readily purchase nutrient-dense foods with a healthy agenda in mind. High income populations may select positive food choices because of better access to health or nutrition information and social or familial influences.

As household income falls, there is an abatement in nutrient quality among the foods purchased by low income populations. Lower income households purchase more cereals, pasta, added sugars, and fatty low-cost meat products (Drewnowski & Eichelsdoerfer, 2009). The most significant changes in food consumption patterns occur for "per capita annual incomes below 12,500 dollars" (Gerbens-Leenes, Nonhebel, & Krol, 2010); this suggests that low income households' food consumption patterns are motivated by price sensitivity rather than nutrition goals or guidelines. Low income households striving to maintain low fixed food costs, especially when anticipating waning income, are pushed towards unhealthy energy-dense foods. To further support these assertions, there is no evidence of positive dietary shifts by low income adults and children in the United States even with major changes in food consumption patterns with this segment (Popkin, 1994). The increased price sensitivity of low income groups paired with low-priced unhealthful foods indicates that low household income corresponds with a higher inclination to consume processed meats and other nutrient-poor foods that are high in sugar and fat; these types of food choices are rational from an economic angle. If fresh meat prices are beyond lower income individuals' earning capacity, cheaper processed meats may be a feasible alternative.

Income and nutritional choices are also related to national aggregate output. Many areas around the world have transitioned from widely agrarian spaces to urban metropolises over the past two centuries with increases in gross domestic output and per capita income; food consumption patterns have changed respectively. National income and economic health affect individuals' nutriment behavior. Now, high-fat animal product diets are significantly more prevalent in urbanized high income populations than

in rural low income populations; this is true in studies conducted in Latin American, Asian, and Western European countries that have modern societies (Popkin, 1994). As developing nations evolve and per capita income increases, malnutrition ceases and overnutrition breaks into focus, which results in chronic disease. Low income rural nations with less economic development still primarily consume high-carbohydrate, low fat diets composed of grains, vegetables, and little meat and are subject to serious food insecurity. Consumers in high income countries may have more freedom to make food choices because of increased available capital; prosperous nations have access to processed or packaged foods through greater infrastructure in food production industries or international trading capabilities. Conversely, consumers in low income countries choose whatever foods are accessible, which tend to be limited varieties from subsistence farming sources. This reinforces the notion that national income changes from economic development and have an extensive effect on food consumption choices and patterns.

Meat Consumption in the U.S.

Meat consumption increases with economic development. Total meat consumption in the United States has steadily increased over the last fifty years, but has consistently been nearly double that of any other developed nations as a whole (Daniel, Cross, Koebnick, & Sinha, 2011). Other data indicates meat consumption behaviors are strongly predicted by sociodemographic factors and vary by gender, age, education levels, and ethnicity or race. These elements affect the types and amounts of meat eaten, as well as knowledge and attitudes about meat-related dietary choices (Guenther, Jensen, Batres-Marquez, & Chen, 2005).

As studied by the World Cancer Research Fund and American Institute for Cancer Research in a paired comprehensive global diet and cancer report, "production and consumption of red meat and processed meat generally rise with increases in available income" (World Cancer Research Fund/American Institute for Cancer Research, 2007). Affluent countries such as the United States, northern Europe, and parts of South America and Asia have a higher percentage of meat consumption at 10% of total energy intake as compared to 7% in lower-income areas (World Cancer Research Fund/American Institute for Cancer Research, 2007); this is attributable to differing preferences and resources in these areas as well as meat-eating being a cultural and societal indicator of prosperity. Additionally, the amount of meat eaten per capita is definitely influenced its supply and demand in the market; a higher supply of meat translates into greater consumption and vice versa.

Processed Meat Consumption

According to an evaluation of meat consumption data collected by NHANES, 22% of all red meat and poultry consumed in the United States is processed meat (Daniel, Cross, Koebnick, & Sinha, 2011). On average, men eat larger quantities of all types of meat per day as compared to females, and the highest consumption is derived from individuals aged 20-49 (Daniel, Cross, Koebnick, & Sinha, 2011). Comparing demographics, Hispanics report a lower processed meat intake than Caucasian or African American people (Daniel, Cross, Koebnick, & Sinha, 2011). Specifically to pork distribution, "individuals with higher than average consumption of processed pork products include those in the Northeast and Midwest, those in households with young

children, non-Hispanic blacks, and those with lesser household incomes" (Guenther, Jensen, Batres-Marquez, & Chen, 2005). Ultimately, lower income communities consume larger proportions of fatty meats. Analyses of research and diet studies administered inside and outside of the United States report notable amounts of processed meat consumption across many demographics, geographic areas, cultures, genders, age groups, and homes. USDA yearly reports and analyst projections suggest that the greatest percentage of processed meat is purchased at grocery stores or supermarkets and consumed in the home.

Analysis

What comprises consumer demand?

Consumer demand is formed by the relationship between price and quantity demanded of a good in addition to other determinants including product quality, advertising, preferences, and market or environmental factors (Andreyeva, Long, & Brownell, 2010). Demand's dynamic nature is motivated by an individual's willingness to pay for a good, which changes as income and preferences are adjusted. Holding all variables constant, an increase in the price of a good will decrease its demand, and a decrease in the price of a good will increase its demand.

Price Elasticity

The impact of changing food prices on consumption varies among food groups. With chronic diseases in the U.S. on the rise along with healthcare costs, it is reasonable to evaluate the effects of price elasticities on food items that may cause such illnesses.

Price elasticity of demand is defined as the percentage change in quantity purchased (demand) per 1% change in price. This is a measure used to estimate quantity demand changes attributed to subsequent price changes. Price elasticity of demand is calculated as percentage change in quantity demanded divided by percentage change in price. Price elasticities are important considerations when modeling the magnitude of any policy changes affecting consumer demand. In theory, higher estimated elasticities imply larger changes in consumer purchasing behavior with price shifts.

Price elasticity is affected by the availability of substitute goods, complementary goods, individual income, consumer preferences, and a good's price relative to income (Browning & Zupan, 2014). A good's price is perfectly elastic when a change in price infinitely changes quantity; this is measured by a price elasticity of demand value of greater than 1. A good's price is perfectly inelastic when a change in price does not cause a change in demand; this is measured by a price elasticity of demand value of zero. The demand for a good is unit elastic when the percent change in price exactly equals the percent change in demand. Generally, price elasticity of demand values lying between zero and 1 indicate inelastic demand, which indicates that consumers do not significantly (or at all) change consumption behaviors with related changes in specific good prices.

If demand for a particular food category is elastic and policymakers want to change its consumption, pricing changes through taxation are feasible. However, when one good's price changes, that adjustment may affect the demand for another related or unrelated good. These relationships are quantified by cross price elasticities of demand, which aid in determining substitute goods and are fundamental to predict the effect of price changes. Additionally, income elasticities measure the receptivity of demand for a

particular good to changes in an individual's income. Ordinarily, cross price and income elasticities are related through price changes of a particular good; the cross price elasticity of demand and income elasticity of demand for a good both increase if the price of a particular good rises (Sabatelli, 2016).

Although income elasticities are useful in determining changes in purchasing habits related to income, policymakers taxing processed meats should instead be concerned with whether price elasticities vary among income groups. Because processed meats are consumed in higher proportions by low income demographics, it is essential to determine if price elasticities are greater and therefore have a magnified impact on low income household consumption of those products. If price elasticities of processed meats are larger for low income consumers than high income consumers, then a tax on processed meats will affect its consumption by low income consumers primarily, and vice versa.

Meat Elasticity

According to a literature review study conducted by Andreyeva, Long, & Brownell (2010), price changes pertained to food are generally inelastic; however, estimated price elasticities of meat are placed in a higher range between 0.68-0.75. However, because meat consumption varies by income, processed meat price elasticities may subsequently vary by income. Exact processed meat elasticities have not been isolated, but research suggests that this meat grouping is relatively inelastic.

Despite these findings, food purchased and consumed "away from home" at external vendors such as restaurants produced a more elastic demand value at 0.81 versus

"food at home's" value of 0.59 (Andreyeva, Long, & Brownell, 2010). Spending on foods prepared away from home increased from 25% in 1970 to 40% in 1995, and the volume of meals and snacks consumed at fast-food restaurants rose by 200% within that time period (Drewnowski & Darmon, 2005). Largely, modern fast-food restaurants and certain cuisines in restaurants rely on processed meats as a main ingredient of dishes sold. Although the demand, purchase, and consumption of processed meats may not be viably reduced through primary retailers such as grocery and convenience stores, a tax on processed meats purchased at restaurants could provide a magnified effect on reducing consumption.

Income and Price Sensitivity

On average, processed meats are consumed more frequently and in higher amounts by individuals with lower incomes than those earning higher incomes. This suggests that processed meat products are of "greater relative importance" or staples in low income diets (Guenther, Jensen, Batres-Marquez, & Chen, 2005). Individuals with lower incomes also change food consumption patterns to a larger degree when faced with price increases than any other income group. There are no price elasticities deduced for processed meats and low income individuals in existing research; however, it is reasonable to conclude that the price elasticities are larger for low income consumers when compared with high income consumers because poor consumers are forced to budget changes in food prices differently than wealthy individuals. This is because processed meats and other items comprise a larger share of the budget in poor households than wealthy households.

Although low income demographics are not inclined to make positive food choices when faced with a price differential, a sales tax targeted specifically to processed meats may at least deter this group from consuming processed meats because a large portion of daily calories is derived from this food group. Research shows that "lowering the price of healthier foods and raising the price of less healthy alternatives shifts purchases towards healthier food options" (Andreyeva, Long, & Brownell, 2010). In this argument, only the price of less healthy foods is directly affected through a tax although it indirectly lowers the relative price of healthy foods. If the goal of taxation is to limit consumption of processed meats, then lowering the prices of foods promoting healthy behaviors is a joint venture.

Discussion

Why Taxes May be Effective

Unhealthful junk foods including soda, candy, and packaged items are clearly overconsumed in America. Because of this overconsumption of specified foods that are detrimental to public health, economists agree that government interference is justified to equilibrate market conditions to reduce consumption back to a reasonable level (Brownell et al., 2009). Due to the low price and absolute harmful effects of processed meats, it is reasonable to assert that processed meats are consumed in large enough proportions to be taxed.

As previously explained, sales taxes on processed meats are likely to principally effect low income demographics. Although explicit price elasticities for processed meats and low income populations have not been isolated, research suggests that changes in

processed meat consumption as related to price is greater for low income populations. For example, Drewnowski and Darmon (2005) concluded that "there is an inverse relationship between energy density of foods and energy cost, such that energy-dense grains, fats, and sweets represent the lowest-cost dietary options to the consumer." In the case of a sales tax on processed meats, low income individuals will receive the majority of the burden of an increase in price; this is more likely to deter this group from consuming processed meats. Additionally, the poor experience a superfluous amount of diet-related diseases as compared to affluent populations, which may be attributed to a disproportionate quantity of processed meat consumption. If processed meat prices rose relative to healthy fruit and vegetable options, low income consumers may purchase and consume the produce rather than the meat.

Why Taxes May be Ineffective

There are several reasons taxing processed meats may be ineffective in reducing its consumption. First, populations affected by the tax may substitute processed meats for other unexpected goods. The probability of substitution between processed meats and another good is demonstrated by the concept called cross price elasticity. The cross price elasticities for substitute foods are greater as the price of processed meats rise, especially in low income households. However, the rate and changes in substitution are not uniform across all food categories by all household income levels and lower income consumers may "resort to greater substitutions within a food subcategory," lowering the predictability of how targeted consumers will change consumption behaviors (Regmi, 2001).

If the price elasticities or cross price elasticities of taxing processed meats are impactful enough to significantly affect consumption for some groups, consumers may substitute into inexpensive protein sources such as eggs or legumes, or into unintended and unhealthy junk food. If the latter occurs, there are no positive consequences of the population's health with a processed meat tax.

When searching for substitutes for processed meats, there are a plethora of health-oriented articles, novels, and advocates which suggest swapping deli meats, sausages, and breaded varieties for its raw form. However, an upcoming and probable substitute for processed meats in the health-conscious, upper-to-middle class population is plant-based meat substitutes. Annual meat substitute sales are expected to grow to nearly $800 million by 2022 from $550 million in 2012 (Durisin & Singh., 2018). Although there is not convincing evidence identifying specific substitutes for processed meats, it is an area of interesting future research.

Second, individuals' attitudes and education retention on nutrition varies across countless variables. Individuals who consume processed meats are less likely than others to believe that a low fat diet are important to a healthy lifestyle; they are also less likely to place importance on consuming a variety of foods, especially fruits and vegetables (Guenther, Jensen, Batres-Marquez, & Chen, 2005). 75% of people factor "ease of preparation" of food essential in making dietary choices, and processed meats are typically already prepared or pre-cooked.

Populations who consume processed meats are more inclined to make other poor dietary choices and gravitate to more calorie-dense, high fat foods that pose an inclined risk of chronic disease. Conversely, those populations who would be receptive to the tax

because of more sophisticated knowledge bases or resources are not the people consuming processed meats in important quantities. A processed meat tax may be ineffective because the targeted population does not hold a strong knowledge base or correspondent belief system or rational awareness about the importance of a healthy diet. Nonetheless, attitudes may be changed over time, especially with education.

Third, low income households who typically consume processed meats may possess low access to the infrastructure helpful to making healthy choices that may contribute to a higher processed meat intake compared to a lesser fruit and vegetable intake. These demographics may not have access to stores that carry fresh produce over refined packaged products due to location disadvantages. Furthermore, lower-income urban neighborhoods have smaller and fewer stores in surrounding areas that charge higher food prices for perishable items as compared to higher-income neighborhoods (Cassady, Jetter, & Culp, 2007).

A study connecting types and quantities of food stores with neighborhood demographics found that "poorer areas and non-White areas tended to have fewer fruit and vegetable markets, bakeries, specialty stores, and natural food stores" and fewer supermarkets in low income areas overall (Moore & Diez Roux, 2006). Additionally, 18% of smaller grocery stores in minority areas offer healthy foods as compared to 58% of supermarkets in largely White neighborhoods (Moore & Diez Roux, 2006). Although there are extraneous factors that attribute to eating habits outside of store availability, the research suggests that geographic regions do affect food opportunity and that race is often a proxy of income.

In addition, individuals may purchase processed meats due to absence of "kitchen facilities, cooking skills, or time" required to prepare lean proteins or other plant foods (Drewnowski & Eichelsdoerfer, 2009). Even if a sales tax created a higher financial strain on individuals who purchase processed meats, it may not reduce consumption because that population chooses to buy that food because of lack of equipment necessary to prepare other items.

Compared to several decades ago, America's workforce demographics have shifted from households including "at least one person with sufficient time to shop for and prepare meals 'from scratch'" to full-time working parents (Drewnowski & Eichelsdoerfer, 2009). As a result of this change, Americans necessitate convenience foods to accommodate rigorous schedules.

Fourth, sociocultural factors contribute to lifestyle choices and the public's inclination to change them. Because the United States is a land of immigrants, many food behaviors are derived from other areas of the world with particular styles of cooking. Americans descendant from low income nations may not stigmatize obesity and view it as a symbol of beauty or status because those cultures are unaware of the health costs associated with corpulence (Schneider & Lilienfeld, 2008). With less food insecurity in the United States and greater access to high calorie foods, cultural roots and social prominence may inhibit a processed meat tax's effectiveness because some individuals may still choose to consume them.

Lastly, comparable studies evaluating the effects of taxing junk foods determine that taxation may not change consumption at all. The dominating opinion of experts

conclude that modest tax rates "yield substantial revenues to governments, but [are] unlikely to affect obesity rates" (Franck, Grandi, & Eisenberg, 2013). Because obesity is related to or increases the probability of contracting or advancing other chronic diseases or cancer, taxes will also not reduce those effects.

However, high levels of taxation of at least 20% for unhealthful foods will likely lead to measureable effects on obesity and possible long-term effects on chronic disease (Mytton, Clarke, & Rayner, 2012); the most weighable decreases would be on low income households and adolescents, or other populations at risk for obesity (Franck, Grandi, & Eisenberg, 2013). Forms of higher taxation on food are controversial because "health related food taxes are regressive," meaning that low income individuals pay a higher percentage of income in a tax than wealthier populations (Mytton, Clarke, & Rayner, 2012). The fairness of taxation falling primarily on one group creates a dubious political environment and may taint attitudes toward healthful eating initiatives overall.

Small Changes Add Up

Although the price elasticities of increasing processed meat prices via taxation may not make enormous leaps in reducing consumption, small changes in consumer behavior from a variety of food taxes could amass a healthier population. Academics from the USDA conducted a study that found fairly low tax rates of "1 cent per pound and 1 percent of value" would not change consumption significantly, but would generate between $40 and $100 million in tax revenues (Kuchler, Tegene, & Harris, 2004). Additionally, the study concluded that a 10% price increase from a national sales tax on salty snack foods could reduce body weights by between 0.2 and 0.99 pounds per year

(Kuchler, Tegene, & Harris, 2004). Another comparable supportive study estimated that a "national tax of 1 cent per ounce on sugar-sweetened beverages would raise $14.9 billion in the first year alone" (Brownell et al., 2009); Alabama has a slightly smaller population than Indiana, but is estimated to generate $221 million in the first year with this tax (Brownell et al., 2009). If Indiana were to implement a processed meat sales tax, it could yield a considerable amount of revenue that might be used to promote healthy food choices and raise awareness about healthy lifestyle behaviors.

Because healthcare costs are a tremendous concern to the sustainability of the healthcare system, any downward impact on processed meat consumption may contribute to lower disease incidence. For just obesity-related diseases alone, there was an 89% increase in spending on treatment for obesity-related diseases from 1998-2006, which on average costed $1,429 more than for medical care for individuals at healthy weights (Dwivedi & Raftery, 2011). In 2014, the estimated direct cost of treating Indiana residents with cancer totaled $1.83 billion, with indirect costs reaching $11.12 billion (Indiana State Department of Health, 2015). Because healthcare expenses are increasing and burdening, the considerable amount of tax revenue provide considerable state budget relief.

Tax Revenue Utilization

Another question accompanying a processed meat tax is what do policymakers do with the revenue? One idea is to use tax money raised from taxing processed meats to lower prices of healthier foods such as fruits and vegetables with the intentions of encouraging their consumption instead. Even if low income populations know and

understand nutrition science, the prices of healthy goods make their consumption out of reach. Drewnowski and Darmon (2005) concluded that "the current structure of food prices is such that sweet and high-fat foods provide dietary energy at the lowest cost," therefore low income consumers are forced to allocate limited resources towards unhealthy foods. Reducing the prices of expensive fresh produce is helpful in promoting healthy eating initiatives.

Secondly, tax earnings could be funneled through educational wellness programs promoting chronic disease (cancers, cardiovascular disease, obesity, etc.) prevention. Pilot programs called "healthy lifestyle clinics" have popped up in several areas around the country which aim to prevent and treat chronic diseases associated with lifestyle choices including diet. Yet, the public does not support all wellness programs equally; public approval is "clearly related to the level of awareness and attributions" people make about a particular disease or affliction (Oliver & Lee, 2005). This dissonance requires program directors to evaluate what delivery methods and instruction are best to benefit particular conditions, especially those that are heavily correlated to certain individual behaviors.

Efforts that help consumers understand and reinforce the importance of food choices in determining health quality are imperative in lowering disease statistics. The general consensus of education program research statistics suggest that the programs improve individual habits and knowledge about health; however, is unclear to what degree education programs alter individuals' lifestyles. Program effectiveness is likely to be very context specific.

A third option for tax revenue use is to reduce the impact of healthcare costs in Indiana's state budget. The astronomical increase in spending for obesity and cancer-related diseases has burdened state healthcare systems nationwide. Indiana's Health and Human Services budget has risen 30.73% from 2014 to 2018 (Table 1), and is expected to continue to increase in the future (Indiana State Budget Agency). A majority of Indiana's healthcare budget is allocated toward insurance or infrastructure-related treatment of illnesses. If diseases caused by processed meats can be reduced through a sales tax and the tax revenue is applied to health spending, the healthcare burden will be diminished.

Table 1: Demonstrates Indiana's budget increase over the past five years (in billions).

Health and Human Services Totals	**2014-2015**	**2015-2016**	**2016-2017**	**2017-2018**	**2018-2019**
General Fund	3.409	3.285	3.509	3.459	3.772
Dedicated Funds	0.849	0.867	0.934	1.053	1.072
Federal Funds	7.891	9.682	9.823	10.860	11.038
Percent Change YoY	5.35%	13.87%	3.13%	7.75%	3.32%
Total	**12.149**	**13.833**	**14.266**	**15.372**	**15.882**

Conclusion

Nearly one-fourth of all meat consumed in the United States is processed meat. Knowing the health consequences of consumption paired with the financial implications to the healthcare system, it is time to advocate for policy changes to generate a healthier Hoosier population.

Although taxing processed meats may not present large aggregate changes in consumption of these goods, research suggests taxation can have some impact on low income populations, who are the primary consumers of processed meats. With a dynamic food environment and transitioning consumer preferences, any changes are minute.

Research suggests the most effective course of action to improve diet-related population health is to levy a high sales tax on processed meats to meaningfully reduce consumption. Additionally, taxing a wide range of nutrients or unhealthy foods while subsidizing fruits and vegetables is more probable to have a greater consumption impact than taxing isolated goods (Mytton, Clarke, & Rayner, 2012). Such policies I believe will reduce consumption of unhealthful foods, especially when coupled with subsidies on healthy foods, and ultimately reduce the incidence of chronic disease in Indiana.

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